

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Division 26, 27 and 28. These sections supplement requirements of Division 1.

1.2 REFERENCES

- .1 Definitions:
 - .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- .2 Reference Standards:
 - .1 CSA Group
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
 - .2 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit for review single line electrical diagrams and locate as indicated.
 - .1 Electrical controls and distribution system.
- .4 Submit for review Fire Verification Report.
- .5 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.

- .5 If changes are required, notify Departmental Representative and Consultant of these changes before they are made.
- .6 Certificates:
 - .1 Provide CSA certified equipment and materials.
 - .2 Where CSA certified equipment material are not available, submit such equipment material to authority having jurisdiction or inspection authorities for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative and Consultant.
- .7 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work as described in PART 3 - FIELD QUALITY CONTROL.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
 - .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
 - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
 - .4 Post instructions where directed.
 - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
 - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates for control items in English.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Materials and equipment to be CSA certified. Where CSA certified equipment are not available, obtain special approval from authority having jurisdiction or inspection authorities before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections or as shown on mechanical drawings.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction, inspection authorities and/or Departmental Representative.
Porcelain enamel signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with labels as follows:
 - .1 Nameplates: lamacoid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on labels to be approved by Departmental Representative and Consultant prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. as directed by Departmental Representative.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

- .3 Colours: 25 mm wide prime colour and [20] mm wide auxiliary colour.

Prime	Auxiliary	
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.9 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .1 Paint indoor enclosures light gray.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.3 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.4 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.

- .1 Sleeves through concrete: schedule 40 steel pipe or plastic sized for free passage of conduit, and protruding 50 mm or as indicated.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical rooms on latch side of door.

3.6 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1400 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In mechanical rooms: 1400 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Telephone and interphone outlets: 300 mm.
 - .5 Fire alarm stations: 1500 mm.
 - .6 Fire alarm bells: 2100 mm.
 - .7 Door bell pushbuttons: 1500 mm.

3.7 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.8 FIELD QUALITY CONTROL

- .1 Load Balance:

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.9 SYSTEM STARTUP

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with building and management guidelines:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00.

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65-03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wire and box connectors from [nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 NEMA to consist of:
 - .1 Connector body and stud clamp for round copper conductors.
 - .2 Clamp for round copper conductors.
 - .3 Clamp for ACSR conductors.
 - .4 Stud clamp bolts.
 - .5 Bolts for copper conductors.
 - .6 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, TECK cable, flexible conduit as required to: CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2/NEMA.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with general guidelines.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with general guidelines.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Refer to all sections of the specifications for related work.

1.2 REFERENCES

- .1 CSA 22.2 No. 0.3 Test Methods for electrical Wires and Cables

1.3 PRODUCT DATA

- .1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE Jacketted.
- .3 Copper conductors: size as indicated, with thermoplastic insulation type TWH rated at 600 V.
- .4 Neutral supported cable: 1, 2, 3 phase insulated conductors of Copper and one neutral conductor of Copper reinforced, size as indicated. Type: Insulation: Type NSF-2 flame retardant rated 600 V.

2.2 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Ethylene propylene rubber EP.
 - .2 Cross-linked polyethylene XLPE.
 - .3 Rating: 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized steel.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .7 Fastenings:

- .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
- .2 Channel type supports for two or more cables spaced as per CEC.
- .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight approved for TECK cable.

2.3 ARMOURED CABLES

- .1 Conductors: insulated, copper size as indicated.
- .2 Type: AC90 - lead sheath over cable assembly and under armour.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Type: ACWU90 flame retardant jacket over thermoplastic armour and compliant to applicable Building Code classification for this project.
- .5 Connectors: anti short connectors.

2.4 ALUMINUM SHEATHED CABLE

- .1 Conductors: copper size as indicated.
- .2 Insulation: cross linked polyethylene type RA90 rated 600V.
- .3 Sheath: aluminum applied to form continuous sheath.
- .4 Outer jacket: thermoplastic applied over sheath and to be compliant to applicable Building Code classification for this project.
- .5 Fastenings for aluminum sheathed cable:
 - .1 One hole steel straps to secure surface cables 25 mm and smaller. Two hole steel straps for cables larger than 25 mm. Use aluminum strap only with single conductor cable.
 - .2 Channel type supports for two or more cables.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.

2.5 CONTROL CABLES

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath: thermoplastic jacket.
- .2 Type: low energy 300 V control cable: solid or stranded (as required) annealed copper conductors sized as indicated LVT: 2 soft annealed copper conductors
- .3 Type: 600 V stranded annealed copper conductors, sizes as indicated:
 - .1 Insulation: TWH butyl rubber insulation type RW90 (x-link)
 - .2 Shielding: non-magnetic tape conductors.

2.6 NON-METALLIC SHEATHED CABLE

- .1 Non-metallic sheathed copper cable type: NMD90XLPE size as indicated.

2.7 VARIABLE FREQUENCY DRIVE CABLE

- .1 Cable:
 - .1 Variable frequency drive cable to CAN/CSA C22.2 No. 131.
- .2 Conductors:
 - .1 Copper power and ground.
- .3 Ground conductors:
 - .1 Three bare ground conductors spaced evenly around circumference of cable (sectored ground).
- .4 Insulation:
 - .1 Cross linked polyethylene, 1000V.
- .5 Armour:
 - .1 Continuous aluminum sheath formed into corrugates seamless heath.
- .6 Outer jacket:
 - .1 PVC, UV resistant.
- .7 Fire rating: FT4, HL and AG14.
- .8 Connectors:
 - .1 As for RA90.
- .9 Standard of Acceptance: Nexans Drive-RX cable.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).

- .3 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .4 Conductor length for parallel feeders to be identical.
- .5 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .6 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .7 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .8 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 In surface and lighting fixture raceways in accordance with Section 26 09 43.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.
- .2 Install cable concealed, securely supported by straps and hangers.

3.5 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.

3.6 INSTALLATION OF ALUMINUM SHEATHED CABLE

- .1 Group cables wherever possible on channels.

3.7 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

3.8 INSTALLATION OF NON-METALLIC SHEATHED CABLE

- .1 Install cables.
- .2 Install straps and box connectors to cables as required.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Refer to all sections of the specifications for related work.

1.2 REFERENCES

- .1 CSA Group
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No.41-13, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).
 - .3 CSA C22.2 No.65-13, Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for connectors and terminations and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: obtain inspection certificate of compliance covering high voltage stress from Departmental Representative and include it with maintenance manuals.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for connectors and terminations for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect connectors and terminations from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper long barrel compression connectors to CSA C22.2 No.65 as required sized for conductors.
- .2 Contact aid for aluminum cables where applicable.
- .3 2, 3, 4 way joint boxes type in accordance with Section 26 05 33 - Raceway and Boxes for Electrical Systems.
- .4 2, 3, 4 way junction boxes with respective pothead for conductor cables

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for connectors and terminations installation in accordance with manufacturer's written instructions.

3.2 INSTALLATION

- .1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2No.41.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Refer to all sections of the specification for related work.

1.2 REFERENCES

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-[02], IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
 - .2 CSA International

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect grounding equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size to electrically conductive underground water pipe.

- .2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, soft annealed.
- .3 Grounding conductors: bare stranded copper, soft annealed.
- .4 Insulated grounding conductors: green, copper conductors.
- .5 Ground bus: copper, complete with insulated supports, fastenings, connectors.
- .6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
 - .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

- .9 Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end.
- .11 Ground secondary service pedestals.

3.3 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to secondary 120/600 V system.

3.4 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, distribution panels, cable trays.

3.5 GROUNDING BUS

- .1 Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections size 2/0AWG.

3.6 COMMUNICATION SYSTEMS

- .1 Install grounding connections for sound, fire alarm, security systems, intercommunication systems as follows:
 - .1 Sound, fire alarm, security systems, intercommunication systems as indicated.
 - .2 Make connections to pipes on building side of main valves and tanks. Connect jumpers across boilers to supply and return hot water heating pipes.

3.7 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Refer to all sections of the specification for related work.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted suspended or set in poured concrete walls and ceilings.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Refer to all sections of the specification for related work.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1, 20th Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in the Province of Manitoba, Canada.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on turned edge covers.

2.2 CABINETS

- .1 Construction: welded sheet steel hinged door, handle, lock 2 keys and catch
- .2 Type E Empty: surface return flange mounting as indicated.
- .3 Type T Terminal: surface return flange mounting containing sheet steel 19 mm plywood backboard.

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.

- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.2 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name voltage and phase or as indicated.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Refer to all sections of the specification for related work.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1, 20th Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for [16, 21 and 27] mm conduit. Minimum size: 73 mm deep.

2.5 CONDUIT BOXES

- .1 Cast FS, FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.6 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

2.7 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

2.8 SERVICE FITTINGS

- .1 'High tension' receptacle fitting made of 2 piece die-cast aluminum with housing finish for 1 single 1 duplex two duplex receptacles. Bottom plate with two knockouts for centered or offset installation. 12 x 102 mm extension piece as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Refer to all sections of the specification for related work.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45, Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-[M1984(R2003)], Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3-[05], Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

Part 2 Products

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel or hot dipped rigid galvanized steel threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings or expanded ends.
- .4 Rigid pvc conduit: to CSA C22.2 No. 211.2.

- .5 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .6 FRE conduit
- .7 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal steel.
- .8 Flexible pvc conduit: to CAN/CSA-C22.2 No. 227.3

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 200 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

- .1 Polypropylene.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 Surface mount conduits in existing walls.
- .4 Use rigid galvanized steel threaded conduit except where specified otherwise.
- .5 Use epoxy coated conduit in corrosive areas.
- .6 Use electrical metallic tubing (EMT) except in cast concrete above 2.4 m not subject to mechanical injury.
- .7 Use rigid pvc conduit in corrosive areas.
- .8 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without prewired outlet box, connection to surface or recessed fluorescent fixtures or work in movable metal partitions.
- .9 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .10 Minimum conduit size for lighting and power circuits: 21 mm.
- .11 Install EMT conduit from computer room branch circuit panel to outlet boxes.
- .12 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .13 Mechanically bend steel conduit over 19 mm diameter.
- .14 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .15 Install fish cord in empty conduits.
- .16 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .17 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Refer to all sections of the specification for related work.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.1 No.126.1-02, Metal Cable Tray Systems.
 - .2 CAN/CSA C22.1 No.126.2-02, Non Metallic Cable Tray Systems.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA FG 1-1993, Fibreglass and Cable Tray Systems.
 - .2 NEMA VE 1-2002, Metal Cable Tray Systems.
 - .3 NEMA VE 2-2001, Cable Tray Installation Guidelines.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.
- .3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.
- .4 Identify types of cabletroughs used.
- .5 Show actual cabletrough installation details and suspension system.

Part 2 Products

2.1 CABLETROUGH

- .1 Cabletroughs and fittings: to CAN/CSA C22.1 No. 126.1
- .2 Trays: extruded aluminum 150, 300, 450, 600, 750 mm wide as required with depth of 150 mm.
- .3 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.
 - .1 Radii on fittings: to meet CEC.
- .4 Solid covers for complete cabletrough system including fittings.
- .5 Barriers where different voltage systems are in same cabletrough.
- .6 Ground cable trays with #2 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.

- .7 Provide fire stop material at firewall penetrations.

2.2 SUPPORTS

- .1 Provide splices, supports for a continuously grounded system as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Install complete cabletrough system in accordance with NEMA VE 2.
- .2 Support cabletrough on both sides.
- .3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.2 CABLES IN CABLETROUGH

- .1 Install cables individually.
- .2 Lay cables into cabletrough. Use rollers when necessary to pull cables.
- .3 Secure cables in cabletrough at 6 m centres, with nylon ties.
- .4 Identify cables every 30 m with size 2 nameplates.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Refer to all sections of the specification for related work.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 100-04, Motors and Generators.
 - .2 CSA C22.2 No. 145-M1986 (R2004), Motors and Generators for Use in Hazardous Locations.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC M1-7-1992, Standard for Motors and Generators.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Manitoba, Canada.
 - .2 Indicate dimensions, recommended installation procedure, wiring diagrams, sizes and location of mounting bolt holes and recommended support method.
- .3 Quality Assurance Submittals:
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals:
 - .1 Provide maintenance data for fractional horsepower motors for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 FRACTIONAL HORSEPOWER MOTOR

- .1 Non-hazardous locations: to CSA C22.2 No. 100, EEMAC M1-7.
- .2 Motor with inherent overheating protectors.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install wiring, flexible connections and grounding.
- .2 Check rotation before coupling to driven equipment.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Refer to all sections of the specification for related work.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 100-04, Motors and Generators.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC M1-7-1992, Standard for Motors and Generators.
 - .2 EEMAC M2-1-1966, Standard for Lead Marking and Connections for Single-Phase and Polyphase Induction Motors.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section [01 33 00 - Submittal Procedures].
- .2 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Manitoba, Canada.
 - .2 Indicate:
 - .1 Overall dimensions of motor.
 - .2 Shaft centreline to base dimension.
 - .3 Shaft extension diameter and keyway, coupling dimensions and details.
 - .4 Fixing support dimensions.
 - .5 Dimensioned position of ventilation openings. Details of ventilation duct attachments.
 - .6 Terminal box location and size of terminals.
 - .7 Arrangement and dimensions of accessories.
 - .8 Diagram of connections.
 - .9 Starting current and relative data necessary for use in design of motor starting equipment.
 - .10 Speed/torque characteristic.
 - .11 Weight.
 - .12 Installation data.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for motors for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Data necessary for maintenance of motors.
 - .3 Manufacturer's recommended list of spare parts.
- .4 Quality Assurance:

- .1 Departmental Representative reserves the right to witness standard factory testing of motors 50 hp (37.3 kW) and above.
- .2 Submit site tests results of installed electrical systems and instrumentation.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Handle motors with suitable lifting equipment.
- .4 Store motors in heated, dry, weather-protected enclosure.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials and spare parts in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 MATERIALS

- .1 Motors:
 - .1 Non-hazardous locations: to CSA C22.2 No. 100 EEMAC M1-7.
 - .2 Lead markings: to EEMAC M2-1.

2.2 CORROSION PREVENTION AND FINISH PAINTING

- .1 Provide equipment resistant to corrosion from severe moisture conditions.

2.3 RATING

- .1 Motor:
 - .1 Single speed: as indicated
 - .2 Enclosure:
 - .3 Operation:
- .2 Squirrel cage

2.4 DESIGN LETTERS

- .1 Polyphase squirrel cage induction motors design
- .2 Single phase integral induction motors design

2.5 ENCLOSURE

- .1 Open drip proof.
- .2 Open guarded.

- .3 Totally enclosed non-ventilated.
- .4 Totally enclosed fan cooled.
- .5 Totally enclosed pipe ventilated for use in non-hazardous location.

2.6 SERVICE CONDITIONS

- .1

2.7 APPLICATION

- .1 Motor suitable for driving fan blower, compressor.

2.8 DUTY CYCLE

- .1

2.9 INSULATION

- .1 Class: B.
- .2 Ambient temperature: 40 degrees C.

2.10 LOCKED ROTOR KVA PER HP

- .1 Locked rotor kVA per hp, code letter.

2.11 DIRECTION OF ROTATION

- .1 Direction of rotation, clock wise when facing end of machine opposite drive.

2.12 BEARINGS

- .1 Antifriction type bearings, fitted with readily accessible facilities for lubrication while motor running or stationary.

2.13 MOTOR MOUNTING AND TERMINAL HOUSING

- .1 Vertical [flange] mounting with thrust bearing.

2.14 SHAFT

- .1 Standard.

2.15 STARTING METHOD

- .1 Terminate winding connection necessary for appropriate starting method and identify in motor terminal box.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Dry out motor if dampness present in accordance with manufacturer's instructions.
- .2 Install motor ensuring it has fully cured before installation rigid plumb and square, using only lifting facilities provided.
- .3 Make wiring connections.
 - .1 Use liquid tight pvc jacketed flexible conduit between rigid conduit and motor.
- .4 Make flexible conduit long enough to permit movement of motor over entire length of slide rails.
- .5 Check for correct direction of rotation, with motor uncoupled from driven equipment.
- .6 Align and couple motor to driven machinery to manufacturer's instructions, using only correct parts such as couplings, belts, sheaves, as provided by manufacturer.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for low voltage control system designed to provide remote switching of lighting loads by use of:
 - .1 Low voltage momentary contact switches.
 - .2 Manual switch control.
 - .2 Sustainable requirements for construction and verification.
- .2 Related Requirements
 - .1 Section 26 09 43.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in the Province of Manitoba, Canada.
- .3 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Test reports:
 - .1 Submit certified test reports indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Manufacturer's Instructions: submit manufacturer's installation instructions.
 - .4 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 MATERIALS

- .1 Control system: by one manufacturer and assembled from compatible components.

2.2 REMOTE CONTROL SWITCHES

- .1 Single pole, double throw, momentary contact, heavy duty, rated 20A, 25 V, double push-button action with pilot lights.

2.3 LOW VOLTAGE RELAYS

- .1 Electrically operated by momentary impulse, mechanically latched until activated.
- .2 Two coil solenoid type with one coil to close relay contacts and one coil to open relay contacts.
- .3 Operating voltage: 24 V, AC.
- .4 Load contacts: 20 A, 120 V, AC.
- .5 Auxiliary contacts for pilot light.
- .6 Coloured pre-stripped leads.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Actuate control units in presence of Departmental Representative to demonstrate lighting circuits are controlled as designated.
- .3 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .4 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Low-emitting materials.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.1-09, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.

1.3 SUMMARY

- .1 The lighting control system specified in this section shall provide manual lighting control.
- .2 The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed)
- .3 All system devices shall be networked together enabling digital communication and shall be individually addressable.
- .4 The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity even if network connectivity to the greater system is lost.
- .5 The system architecture shall facilitate remote operation via a computer connection.
- .6 The system shall not require any centrally hardwired switching equipment.
- .7 The system shall be of a wired architecture.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for network lighting controls and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Manitoba, Canada.
 - .2 Indicate on drawings:
 - .1 Complete assembly.
 - .2 Contact surfaces.
 - .3 Construction features.
 - .4 Wiring diagrams.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for network lighting controls for incorporation into manual.
- .3 Product Datasheets (general device descriptions, dimensions, wiring details, nomenclature)
- .4 Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices)
- .5 Other Diagrams – as needed for special operation or interaction with other system(s)
- .6 Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up
- .7 Hardware and Software Operation Manuals
- .8 Other operational descriptions as needed

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect network lighting controls from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.7 QUALITY ASSURANCE

- .1 Include population of all electronic components on circuit boards, soldering, programming, wiring, and housing.
- .2 All components and the manufacturing facility where product was manufactured must be ROHS compliant.
- .3 In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.
- .4 All applicable products must be UL / CUL Listed or other acceptable national testing organization.

1.8 COORDINATION

- .1 Coordinate lighting control components to form an integrated interconnection of compatible components.

- .2 Coordinate lighting controls with BAS (if necessary) either through IP based intercommunication of system or hardwired auxiliary relay outputs.
- .3 The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

1.9 WARRANTY

- .1 All devices in lighting control system shall have a 5 year warranty.

Part 2 Products

2.1 GENERAL

- .1 Provide hardware that is designed, tested, manufactured, and warranted by a single manufacturer.
- .2 BACnet Interface:
 - .1 Provide ability to communicate by means of BACnet IP or BACnet Ethernet communication to centralized lighting system from user-supplied 10BaseT Ethernet network.
 - .2 Provide PIC list definition and object model to other system manufacturers.

2.2 SYSTEM ARCHITECTURE

- .1 All switching relays shall be located within power (relay) pack device.
- .2 All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located device).
- .3 System shall have a primary wall mounted network control “gateway” device that is capable of accessing and controlling all other system devices and linking into an Ethernet LAN.
- .4 System shall use “bridge” devices that route communication and distribute power for up to 8 lighting zones together for purposes of decreasing system wiring requirements.
- .5 All devices within a single lighting zone shall be capable of being daisy-chain wired with CAT-5E low voltage cabling.
- .6 Communication and Class 2 system power shall be delivered to each device via standard CAT-5E low voltage cabling with RJ-45 connectors.
- .7 All system devices shall have at least two RJ-45 ports.
- .8 All wall mounted user control / gateway devices shall be low voltage, fit within a two gang switch box, and have a backlit LCD panel. User control shall be made available via finger-touch buttons with no moving parts.
- .9 System must have a web-based software management program that enables system control, status monitoring, and creation of lighting control profiles.
- .10 Each control gateway device shall be capable of linking 400 devices to the management software.

- .11 Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure or the management software becoming unavailable.
- .12 System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to the commands input of the targeting system or the wall controls.

2.3 LIGHTING CONTROL PROFILES

- .1 Changes to the operation of the system can be made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
- .2 Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
- .3 All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy and local user switches via lighting control profiles.
- .4 Every device parameter shall be configurable via a lighting control profile.
- .5 All lighting control profiles shall be stored on the network gateway device and on the software's host server.
- .6 Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.4 MANAGEMENT SOFTWARE

- .1 Every device parameter shall be available and configurable remotely from the software.
- .2 Status monitoring information shall be made available from the software for all devices for which it is applicable.
- .3 The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.
- .4 A printable network inventory report shall be available via the software.
- .5 Up to 40 simultaneous user sessions shall be capable of being supported.
- .6 Software shall require all users to login with a User Name and Password.
- .7 Software shall provide at least three permission levels for users.
- .8 All sensitive stored information and privileged communication by the software shall be encrypted.
- .9 All device firmware and system software updates must be available for automatic download and installation via the internet.

2.5 POWER (RELAY) PACKS AND SUPPLIES

- .1 Power Packs shall accept 120VAC, be plenum rated, and provide Class 2 power to the system.
- .2 All devices shall have two RJ-45 ports.

- .3 Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
- .4 Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
- .5 Power Pack must be installed inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
- .6 Power Pack shall incorporate a Class 1 relay and contribute low voltage power to the rest of the system. Slave Packs shall incorporate the relay, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
- .7 Class 1 Relays used in Power (Slave) Packs shall provide 16 Amp switching of all load types, and be rated for 400,000 cycles.

2.6 WALL SWITCHES AND DIMMERS

- .1 Devices shall recess into single-gang switch box and fit a standard GFI opening.
- .2 Devices shall provide user control via touch sensitive buttons that utilize no mechanical parts.
- .3 Devices shall be available with zero or one integrated Class 1 switching relay.
- .4 Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5E low voltage cabling with RJ-45 connectors.
- .5 All sensors shall have two RJ-45 ports.
- .6 All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
- .7 Devices shall be available in white color.
- .8 Devices with dimming control outputs can control 0-10V drivers.

Networked System Wall Switches & Dimmers

- .9 Devices shall recess into single-gang switch box and fit a standard GFI opening.
- .10 Devices shall be available with zero or one integrated Class 1 switching relay.
- .11 Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
- .12 All sensors shall have two RJ-45 ports.
- .13 All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
- .14 Devices shall be White.

- .15 Devices with dimming control outputs can control 0-10 VDC dimmable ballasts by sinking up to 20 mA of current (typically 40 or more ballasts).
- .16 Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.
- .17 Devices with mechanical push-buttons shall provide tactile and LED user feedback.
- .18 Devices with mechanical push-buttons shall be made available with custom button labeling
- .19 Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.

2.7 NETWORKED SYSTEM GRAPHIC WALL STATION

- .1 Device shall have a 3.5" full color touch screen for selecting up to 8 programmable lighting control presets or acting as up to 16 on/off/dim control switches.
- .2 Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.
- .3 Device shall enable user supplied .jpg screen saver image to be uploaded.
- .4 Device shall surface mount to single-gang switch box.
- .5 Device shall have a micro-USB style connector for local computer connectivity.
- .6 Device shall have two RJ-45 ports for communication.

2.8 COMMUNICATION BRIDGES

- .1 Device shall surface mount to a standard 4" x 4" square junction box.
- .2 Device shall have 8 RJ-45 ports.
- .3 Device shall be capable of aggregating communication with connected daisy-chains of system devices.
- .4 Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5E cabled connection.

2.9 NETWORK CONTROL GATEWAY

- .1 Device shall recess into a Lighting Control Panel.
- .2 Device shall provide user control via touch sensitive buttons which have no mechanical parts.
- .3 Device shall have a backlit LCD panel.
- .4 Device shall be capable of communicating on an Ethernet network with a fixed or DHCP assigned IP address.
- .5 Device shall have three RJ-45 ports for connection to system devices and one RJ-45 port for connection to Ethernet network.
- .6 Device shall be powered with Class 2 low voltage supplied locally via a directly-wired power supply or delivered via a CAT-5E cabled connection.

2.10 LIGHTING CONTROL PANEL

- .1 Wall mounted, Industrial Ethernet Enclosure shall be UL Type 4/12, IP66 to meet UL 508A-Standard for Industrial Control Panels.
- .2 The enclosure shall have a removable pre-engineered back plate with DIN rails installed to enable rapid installation of switches, pre-installed accessory side panels and cable management L rings. The door shall be equipped with 3mm double bit latches to secure the door. The door shall hinge on the right. Class 2 power circuits shall be separated for IT personnel by isolation barrier.
- .3 Security: 1/4" turn latches with 3mm double bit.
- .4 Grounding: Enclosure to include bonding provisions on body, door, back plate, and grounding bar.
- .5 Enclosure: Grey, 14 gauge cold rolled steel.
Back Panel: 14 gauge galvanealed steel.
- .6 Allen-Bradley® Stratix 5900™
Services Router

2.11 SERVICES ROUTER

- .1 Fully integrated with Cisco IOS, the unit shall use a wide area network (WAN) port and four additional Ethernet-ports to help deliver:
 - .1 Highly secure real-time control communication
 - .2 Secure routing and firewall capabilities
 - .3 Virtual Private Network (VPN)
 - .4 Intrusion protection capabilities
 - .5 Network Address Translation (NAT)
 - .6 NBAR protocol filtering
 - .7 Access Control Lists (ACL)
 - .8 Quality of Service (QoS) for prioritization
 - .9 Extended shock and vibration capability
 - .10 DIN rail mount
 - .11 A temperature range of minus 25 C to 60 C
 - .12 Web-based graphical device management tool
 - .13 Manage and diagnose network issues
 - .14 Alarm tools to alert, identify and help solve network problems
 - .15 PC-based application software for device management of IOS-based products
 - .16 Easy-to-use configuration wizards for router, firewall, intrusion prevention system (IPS), VPN, unified communications, WAN and LAN configurations
 - .17 Cisco Command Line Interface (CLI)
 - .18 EFT/B immunity IEC 61000-4-4: ±500 kV at 5 kHz on Ethernet ports
 - .19 Surge transient immunity IEC 61000-4-5: ±1 kV line-earth (CM) on shielded Ethernet port

- .20 Conducted RF immunity IEC 61000-4-6: 10V rms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz.
- .21 Certifications: c-UL-us UL Listed Information Technology Equipment, certified for US and Canada. See UL File E136709.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for network lighting controls installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

- .1 Install system and components in accordance with manufacturer's instructions.
- .2 Install cables to circuit outlet boxes and connect to power circuit and energize.
- .3 Install Light enclosures as shown on drawings and connect cables to power-in plug.
- .4 Connect joiner cables to each of power-out receptacles.
- .5 Install joiner cables between interceptors in fixtures or equipment. Allow extra cable to facilitate removal and relocation of fixtures or equipment.
- .6 Install blanking plugs in unconnected receptacles.
- .7 Integrally moulded thermoplastic components to match colour identification system (i.e. black for normal power, red for emergency power).
- .8 Install low voltage switch kits and low voltage cables as shown on drawings and connect to control ports of controlled circuits.
- .9 Install sensor kits and low voltage cables as shown on drawings and connect to control ports of controlled circuits.

3.3 FIELD QUALITY CONTROL

- .1 On completion of installation, manufacturer representative shall be notified to carry out site inspection and report any inconsistencies to the Consultant. Corrections are to be implemented to comply with manufacturer's report.

3.4 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by network lighting controls installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.42-[10], General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55-M1986(R2008), Special Use Switches.
 - .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for [wiring devices] and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Manitoba, Canada.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section [01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SWITCHES

- .1 20 A, 120 V, single pole, three-way where indicated switches to: CSA C22.2 No.55 CSA C22.2 No.111.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Ivory toggle.
- .3 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
 - .1 Ivory urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
 - .1 Ivory urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

2.3 SPECIAL WIRING DEVICES

- .1 Special wiring devices:
 - .1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic lense flush type.

2.4 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel, 1 mm thick cover plates cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .4 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

- .5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .6 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

2.5 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform [Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFI type receptacles as indicated.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1-04, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 ASTM International Inc.
 - .1 ASTM F1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 Canadian Standards Association (CSA International)
- .5 ICES-005-07, Radio Frequency Lighting Devices.
- .6 Underwriters' Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires, for approval by Departmental Representative.
- .3 Samples:
 - .1 Provide samples when indicated.
- .4 Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 LAMPS

LED Linear Fluorescent

- .1 LEDs provide 83 CRI at 4000 K or 4100 K.
- .2 Lumen output ranges from 2100 to 6000 lumens. Beam angle is 110 FWHM (full width at half maximum).
- .3 Lumen output up to 1,300 lumens per foot. In 86°F (30°C) ambient environments, L70 is predicted to be 100,000+ hours, L85 at 44,000 hours.

LED downlight:

- .4 LAMP: LED: Monochromatic LED to 64 watts.
- .5 VOLTAGE: MVOLT
- .6 REFLECTORS: Precision formed single piece aluminum reflector with Alanod MIRO® finish to meet beam spread requirements.
- .7 LENS: Flat tempered glass for maximum resistance to impact.
- .8 GLARE CONTROL: Internal glare control and external glare control available.

2.2 DRIVERS

- .1 LED Drivers
- .2 Reliable and consistent operation
- .3 High efficiency >90%
- .4 Greater than 0.9 PF and Less than 20% THD
- .5 Greater than 50,000 hrs life time
- .6 5-year limited warranty
- .7 ROHS compliance
- .8 Safety approbations (UL, CSA, CE, ENEC,
- .9 PSE, SELV or CQC)
- .10 Dimmable and Programmable.
- .11 Designed to meet the needs of LED lighting
- .12 Available in either dedicated input voltage or Intellivolt options
- .13 Dimmable
- .14 The Adjustable Output Current (AOC) feature
- .15 Specific dimmable versions to enable use of lighting controls to help increase energy saving through a wide variety of protocols, such as 0-10V

2.3 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.4 LUMINAIRES

- .1 As indicated in luminaire schedule.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.

3.2 WIRING

- .1 Connect luminaires to lighting circuits:
 - .1 Install flexible or rigid conduit for luminaires as indicated.

3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires independently of ceiling support luminaires from ceiling grid in accordance with local inspection requirements.

3.4 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.141-10, Emergency Lighting Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect emergency lighting from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.6 WARRANTY

- .1 For batteries in this Section 26 52 00 - Emergency Lighting, 12 months warranty period is extended to 120 months.

Part 2 Products

2.1 EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No.141.

- .2 Supply voltage: 120/347 V, AC.
- .3 Output voltage: 24 V DC.
- .4 Operating time: 120 minutes.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .10 Lamp heads: 12V, integral on unit remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED, 5 W, minimum average lumens 340 of minimum output, 920 CBCP, lamp efficacy: 68.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Finish: white.
- .13 Auxiliary equipment:
 - .1 Ammeter.
 - .2 Voltmeter.
 - .3 Test switch.
 - .4 Time delay relay.
 - .5 Battery disconnect device.
 - .6 AC input and DC output terminal blocks inside cabinet.
 - .7 Shelf.
 - .8 Cord and single twist-lock plug connection for AC.
 - .9 RFI suppressors.

2.2 WIRING OF REMOTE HEADS

- .1 Conduit: type EMT, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: Copper type in accordance with Section 26 05 21 - Wires and Cables (0-1000 V), sized in accordance with manufacturer's recommendations.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for emergency lighting installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Departmental Representative. Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Connect exit lights to unit equipment.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by emergency lighting installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Refer to all sections of the specification for related work.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141-02, Unit Equipment for Emergency Lighting.
 - .2 CSA C860-01(December 2002), Performance of Internally-Lighted Exit Signs.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 101-2006, Life Safety Code.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 STANDARD UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Housing: extruded aluminum housing.
- .3 Face and back plates: extruded aluminum.
- .4 Lamps: two - LED-12W, 120V, 200,000 hours.
- .5 Operation: designed for over 100,000 hours of continuous operation without relamping.
- .6 Letters: 150 mm high x 19 mm, with 13 mm thick stroke, white on red glass reading EXIT SORTIE.
- .7 Face plate to remain captive for relamping.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Ensure that exit light circuit breaker is locked in on position.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION